Marine Research on the Kerguelen Plateau: from early scientific expeditions to current surveys under the CCAMLR objectives

by

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ABSTRACT. - Since the discovery of Kerguelen Islands by Yves-Joseph de Kerguelen-Tremarec in 1772 and of Heard Island by Peter Kemp in 1833, a considerable number and a great variety of ships (e.g., sealers, whalers, fishing ships, oceanographic ships, navy ships and sailing boats) visited the Kerguelen Plateau, around Kerguelen Islands and the Heard and McDonald Islands. From 1772 to 1835 (the date of the last sealing voyage from Britain), not less than 78 ships came to the area, of which two have conducted scientific surveys: Cook in 1776 (his 3rd voyage) on board HMS *Resolution* and HMS *Discovery* (hydrographic works); and Rhodes in 1799 on board *Hillsborough* (accurate charting of the northern and eastern coasts of Kerguelen Islands). During the second half of the 19th century and the 20th century, until 1922 (the date of the last sealing voyage from the United States), 223 ships (mostly US sealers) came to Kerguelen and Heard Islands. Only seven expeditions carried-out marine scientific surveys: magnetic observations by Ross (1840, HMS *Erebus*, HMS *Terror*), oceanographic research and scientific observations by Sir C.W. Thomson (1874, HMS *Challenger*), hydrographic surveys by Lieutard (1892, *Eure*), oceanographical observations by Chun (1898, *Valdivia*), sounding and dredging by Von Drygalski (1902, *Gauss*), survey of the south and west coasts of Kerguelen Islands by Ring (1910, *Jeanne d'Arc*), and hydrographic survey by Rallier du Baty (1913, *La Curieuse*). During the years 1923 to 1970, 78 ships visited the area. It is only after 1949-1950 that a regular, systematic exploration of the Kerguelen Plateau began, with the establishment of a shore station at Port-aux-Français. The first marine biological collections were made by Aretas in 1950 (*Lapérouse* and *Commandant Charcot*). In 1951-1952, Herdman (*Discovery II*) and Angot (*Vercors*), made oceanographical studies. In 1957-1958, a comprehensive coastal survey of Kerguelen Islands was achieved with the small motorboat *Commandant Loranchet*. In 1961-1962 the first algological investigations were done (*Galliéni*). In 1961, the first investigation for the fisheries resources for *Notothenia* species off Kerguelen Islands was made by the Soviet Union and France (*Bikin*, *Danko*). From that time, marine biology studies were carried out: benthos research (1962-1963), ichthyological investigations (*L'Oiseau*) (1963-1966) and microbiological studies. The first fish trawling survey around Kerguelen Islands occurred in 1968 (*Sapmer*). In 1968-1969, the construction of a marine biological station at Port-aux-Français helped to develop all studies in marine biology. In 1970, a motorboat (16 m long), *La Japonaise*, was used for marine investigations at Kerguelen Islands. It was replaced by *La Curieuse* (25 m long) in 1989. From 1970 to 1981, the Soviet Union sent about 130 trawlers to the fishing grounds. Poland sent trawlers for fisheries and hydrological survey around Kerguelen, Skiff Bank, Heard and Crozet (*Profesor Siedlecki, Lacerta, Manta*) and from 1981 to 1998, a French trawler (*Austral*) exploited the fishery each year. Several scientific cruises on the Kerguelen Plateau (including Heard Island and the fjords of Kerguelen Islands) were carried out with the *Marion Dufresne* (cruise MD03/ichtyo, 1974; MD04/benthos, 1975; MD08/benthos, 1976). The *Marion Dufresne* participated in Biological Investigations of Marine Antarctic Systems and Stocks programmes (BIOMASS) in south western area of the Kerguelen Plateau (MD24/Biomasse, 1980; MD25/FIBEX, 1980-1981; MD42/SIBEX, 1982-1983). In 1978, France declared an exclusive economic zone of 200 nautical miles around Kerguelen Islands, Crozet, Saint-Paul and Amsterdam. In 1979, Australia did the same around Heard and McDonald Islands. A series of fish and krill investigations and surveys off Kerguelen Islands were made in 1979 (*Jutland*, *Melitopoj, Ritsa, Kadanchik*), and in 1983 (*Austral*). Since 1981, one or several trawlers or longliners exploited the fishing grounds, with an observer on board. In 1982, the first meeting of the scientific Committee of the Convention for the Conservation of Antarctic Marine Living Resources (CCAMLR) took place in Hobart.

RÉSUMÉ. - Recherches marines sur le plateau de Kerguelen : des premières expéditions scientifiques aux campagnes actuelles répondant aux objectifs de la CCAMLR.

Depuis la découverte des îles Kerguelen par Yves-Joseph de Kerguelen-Tremarec en 1772 et de l'île Heard par Peter Kemp en 1833, un nombre considérable et une grande variété de navires (par ex. des navires chasseurs de phoques ou de baleines, des navires de pêche, des navires océanographiques, des navires militaires et des voiliers) ont exploré le Plateau de Kerguelen, autour des îles Kerguelen et des îles Heard et McDonald. De 1772 à 1835 (date de la dernière campagne de chasse aux phoques envoyée par la Grande-Bretagne), ce n'est pas moins de 78 navires qui vinrent dans la zone. Deux d'entre eux seulement ont mené des recherches scientifiques : Cook en 1776 (au cours de son 3e voyage) à bord du HMS *Resolution* et du HMS *Discovery* (travaux hydrographiques) et Rhodes en 1799 à bord du *Hillsborough* (carte détaillée des côtes nord et est des îles Kerguelen). Pendant la seconde moitié du XIXe siècle et le XXe siècle, jusqu'en 1922 (date de la dernière campagne de chasse aux phoques envoyée par les États-Unis), 223 navires (surtout des chasseurs de phoques américains) fréquentèrent les eaux des îles Kerguelen et Heard. Sept expéditions seulement conduisirent des explorations scientifiques marines : observations magnétiques par Ross (1840, HMS *Erebus*, HMS *Terror*), recherches océanographiques et observations scientifiques par Sir C.W. Thomson (1874, HMS *Challenger*), travaux hydrographiques par Lieutard (1892, *Eure*), observations océanographiques par Chun (1898, *Valdivia*), sondages et dragages par Von Drygalski (1902, *Gauss*), exploration des côtes sud et ouest des îles Kerguelen par Ring (1910, *Jeanne d'Arc*), et travaux hydrographiques par Rallier du Baty (1913, *La Curieuse*). Pendant les années 1923 à 1970, 78 navires visitèrent la zone. Ce n'est qu'après 1949-1950 qu'une exploration systématique du Plateau de Kerguelen commença avec l'installation d'une station côtière à

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The Kerguelen Plateau: marine ecosystem and fisheries: 5-13.

Port-aux-Français. Les premières collections d'organismes marins furent réalisées par Aretas en 1950 (*Lapérouse* et *Commandant Charcot*). En 1951-1952, Herdman (*Discovery II*) and Angot (*Vercors*) firent des études océanographiques. En 1957-1958, une exploration côtière détaillée des îles Kerguelen fut réalisée avec une petite vedette, le *Commandant Loranchet*. En 1961-1962, les premières recherches en algologie furent réalisées (*Galliéni*). En 1961, les premières recherches sur les ressources halieutiques pour les espèces du genre *Notothenia* furent réalisées au large des îles Kerguelen par l'Union soviétique et la France (*Bikin*, *Danko*). A partir de cette date, des travaux en biologie marine furent conduits régulièrement : recherches sur le benthos (1962-1963), sur les poissons (*L'Oiseau*)(1963-1966) et en microbiologie. La première campagne de chalutage autour des îles Kerguelen se déroula en 1968 (*Sapmer*). En 1968-1969, la construction d'une station de biologie marine à Port-aux-Français facilita le développement des études de biologie marine. En 1970, une vedette (16 m de longueur), *La Japonaise*, fut utilisée pour les recherches marines. Elle fut remplacée en 1989 par un petit navire bien équipé (25 m de longueur), *La Curieuse*. De 1970 à 1981, l'Union soviétique envoya environ 130 chalutiers sur les fonds de pêche. La Pologne mit en œuvre plusieurs chalutiers pour une exploration halieutique et hydrologique autour de Kerguelen, du Banc Skiff et des îles Heard et Crozet (*Profesor Siedlecki*, *Lacerta*, *Manta*) et de 1981 à 1998, un chalutier français (*Austral*) exploita la pêcherie chaque année. Plusieurs campagnes scientifiques sur le Plateau de Kerguelen (y compris l'île Heard et les fjords des îles Kerguelen) furent menées avec le *Marion Dufresne* (campagne MD03/ichtyo, 1974 ; MD04/benthos, 1975 ; MD08/benthos, 1976). Le *Marion Dufresne* participa aux programmes Biological Investigations of Marine Antarctic Systems and Stocks (BIOMASS), dans la zone sud-ouest du Plateau de Kerguelen (MD24/Biomasse, 1980 ; MD25/FIBEX, 1980-1981 ; MD42/SIBEX, 1982-1983). En 1978, la France a déclaré la création d'une zone économique exclusive de 200 miles nautiques autour des îles Kerguelen, Crozet, Saint-Paul et Amsterdam. En 1979, l'Australie fit de même autour des îles Heard et McDonald. Une série de recherches et d'explorations halieutiques autour des îles Kerguelen fut réalisée en 1979 (*Jutland*, *Melitopoj*, *Ritsa*, *Kadanchik*), et en 1983 (*Austral*). Depuis 1981, un ou plusieurs chalutiers et/ou longliners exploitent les fonds de pêche, avec un observateur à bord. En 1982, la première réunion du Comité scientifique de la Convention pour la Conservation de la faune et de la flore marines de l'Antarctique (CCAMLR) s'est réunie à Hobart.

Key words. - History - Kerguelen Plateau - Marine research - Heard/McDonald - Scientific surveys.

The islands of the Kerguelen plateau (Kerguelen, Heard and McDonald) are located in the South Indian Ocean, halfway between South Africa and Australia. More than 1500 nm distant from any continent, these islands are the most isolated ones in the world. This isolation explains why Kerguelen Islands were not discovered until 1772 by Yves-Joseph de Kerguelen-Tremarec on board the *La Fortune* (Fig. 1) and the *Gros Ventre;* and Heard and McDonald Islands in 1833 by Peter Kemp on board the *Magnet* (and rediscovered by John J. Heard in 1853 aboard the *Oriental*) (Headland, 1989).

On 25 December 1776, James Cook (HMS *Resolution)* (Fig. 2) during his third voyage around the world, and Charles Clerke (HMS *Discovery*) confirmed the discovery of Y.J. de Kerguelen-Tremarec and gave the name Desolation Islands to the islands, and also, to pay homage to their discoverer, Kerguelen Islands. The expedition conducted important hydrographic works, made a tour of the archipelago and demonstrated that they were separate from any other landmass. Twenty-five years later, in 1799, on the return voyage from Sydney, Capt. Rhodes (*Hillsborough*) from London spent eight months surveying the northern and eastern coasts of Kerguelen Islands, while his crew were sealing and whaling. His chart was a work of exceptional accuracy for that date.

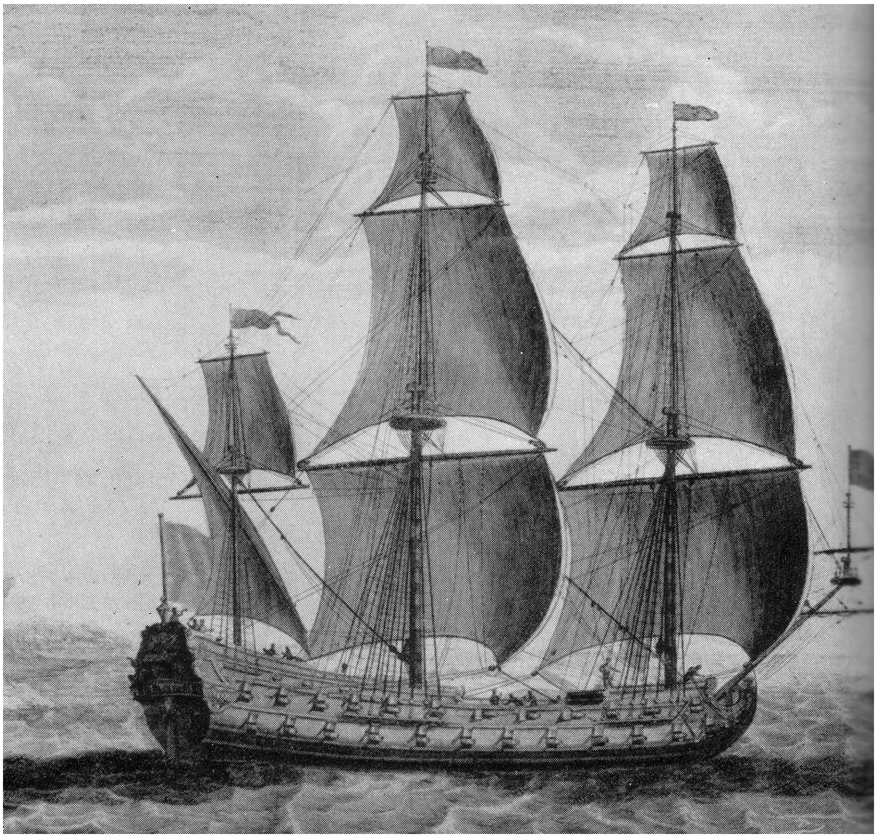

Figure 1. - Sister ship of *La Fortune* (there is no known representation of *La Fortune*).

During a British naval expedition (1839-43), James Clark Ross (HMS *Erebus*) and Francis Crozier (HMS *Terror*) visited Kerguelen Islands in 1840. They primarily conducted a series of magnetic and tidal observations and captured a large number of marine animals which resulted in the first specimens of fish from Kerguelen Islands discovered during their visit. The fishes were described later in 1844 by J. Richardson who was on board the *Erebus* as naturalist: *Channichthys rhinoceratus*, *Indonototheniа cyanobrancha*, *Notothenia coriiceps* and *Notothenia rossii* (Richardson, 1844-48).

Figure 2. - HMS *Resolution*.

From 1791 to 1835, the Kerguelen and Heard Islands were frequently visited by sealers from Britain, the United States of America and France. It was the sealing era. More than 94 ships (sealers and whalers) visited the area until 1835 when the last British sealing voyage by A. Distant (*George Howe*) occurred. Afterwards, 171 ships from 15 countries visited the Kerguelen Plateau until 1922, when the last US sealing expedition to Antarctic regions, Kerguelen and Heard Islands, was organised by Benjamin Dunham Cleveland from New Bedford (*William A. Graber*). Sealing and whaling were a profitable trade which started in 1791 and lasted for 130 years.

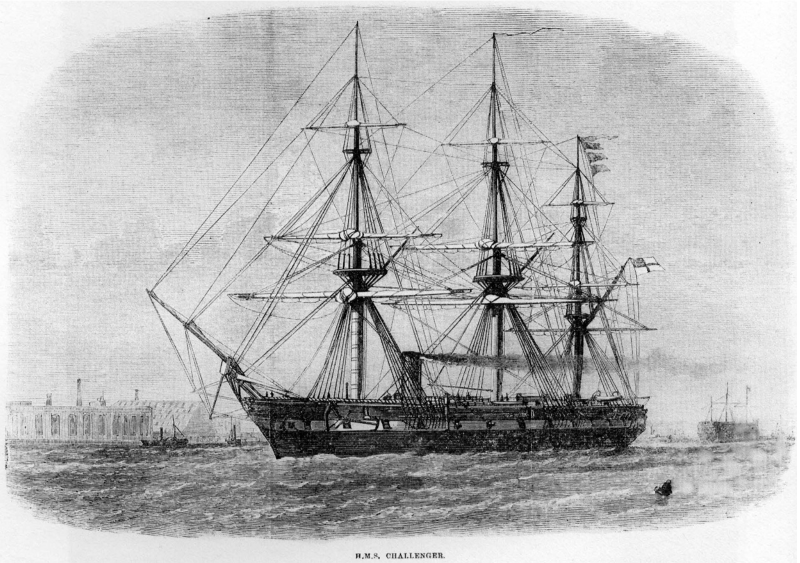
H.M.S. CHALLENGER.

Figure 3. - HMS *Challenger*.

Apart from the Ross expedition, no scientific ship visited the Kerguelen Plateau until the famous British HMS *Challenger* expedition (Fig. 3). This voyage was the beginning of the scientific expeditions to the Kerguelen Plateau and the South Seas. From December 1872 to May 1876, the British naval circumnavigation of the Earth took place under the leadership of Sir Charles Wyville Thomson and the command of G.S. Nares (HMS *Challenger*). They conducted important oceanographic and scientific observations around Kerguelen and Heard Islands in January and February 1874. John Murray, one of the two naturalists on board (with Henry Moseley), wrote: "the *Challenger* expedition was the greatest advance in the knowledge of our planet since the celebrated discoveries of the 15th and 16th centuries" (Murray, 1912). Abundant and rich collections of marine animals and plants were collected and now preserved in the Natural History Museum, London. Over three and half years, the HMS *Challenger* circumnavigated the world, crossed the great oceans in many directions, made observations in nearly all departments of the physical and biological sciences and laid down the broad general foundations of the current science of oceanography. The theory of an azoic zone suggested by Edward Forbes in the mid 19th century was then completely demolished. Animal life was shown to be present on the bottom of the ocean at all depths. During 1,000 days at sea, with 362 stations all around the Earth, a total of 4,000 new species were described and a rich data on temperature, salinity and density of seawater were collected along a route of 68,890 nm. At each of these stations, the following observations were made: exact depth, sample of bottom, bottom temperature, sample of bottom fauna, fauna of the surface and of intermediate depths, series of temperature observations at different depths, samples of sea-water, atmospheric and meteorological conditions, direction and rate of the surface current and movement of the water at different depths (Linklater, 1972). In the vicinity of Kerguelen (Fig. 4) and Heard (Fig. 5) Islands, the HMS *Challenger* expedition made a large number of dredging and sounding stations in January and February 1874. Eight new species of fish were collected and described later by A. Günther (1880, 1887): *Bathyraja murrayi*, *Muraenolepis marmoratus*, *Gobionotothen acuta*, *Lepidonotothen mizops*, *L. squamifrons*, *Bathydraco antarcticus*, *Mancopsetta maculata* and *Zanclorhynchus spinifer*. John Murray published, in 50 volumes, all the results of the expedition at his own expense. HMS *Challenger* was the first scientific ship equipped with a true laboratory, the natural history work room (Fig. 6). Names of fishes are those presently adopted in the fish nomenclature (Duhamel *et al.*, 2005; Gon and Hemstra, 1990; Hureau, 1979; Froese and Pauly, 2011).

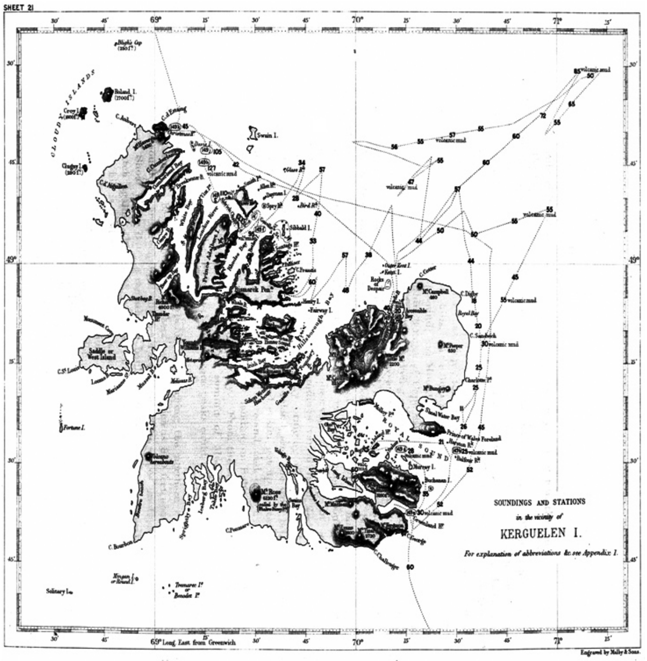
SHEET 21
SOUNDINGS AND STATIONS
in the vicinity of
KERGUELEN I.
For explanation of abbreviations &c. see Appendix I.
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Figure 4. - *Challenger* stations around Kerguelen Islands.

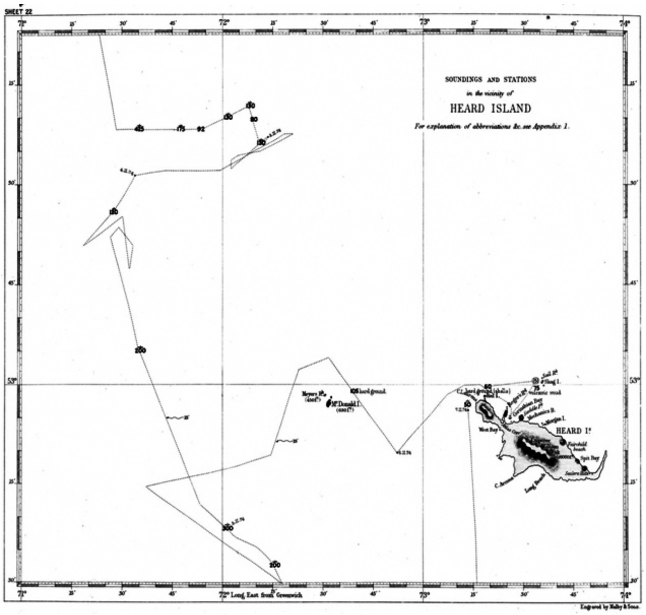
SHEET 22
SOUNDINGS AND STATIONS
in the vicinity of
HEARD ISLAND
For explanation of abbreviations &c. see Appendix I.
HEARD I.
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Figure 5. - *Challenger* stations around Heard and McDonald Islands.

One year later (November 1874-February 1875), an important international cooperation was organised for the observation of the transit of Venus before the Sun. Four countries (Great Britain, the United States, Germany and France) sent expeditions to the sub Antarctic islands. Three went to Kerguelen: Great Britain (HMS *Volage*) in Baie de l'Observatoire, the United States (*USS Swatara*) at Pointe Molloy and Germany (*La Gazelle*) in Anse Betsy. France set up an observatory at St Paul Island. The objective of these expeditions was mainly to conduct astronomical observations but some marine surveys were achieved. An example is the scientific ship *La Gazelle* which made dredging and sounding stations in the north-east of Kerguelen Islands (Fig. 7). In 1876, A. Günther reported the specimens obtained by the British expedition and described a new species of ray, *Bathyraja eatonii*. The fishes collected by the American expedition were dealt with by T.N. Gill (1876) who recorded *Harpagifer bispinis* (Schneider, 1801) (in fact, *Harpagifer kerguelensis* Nybelin, 1947) for the first time in the area. As for the German expedition, the single new fish obtained from this zone has been previously described by J.R. Forster in 1801 from the Magellan region, *Paranotothenia magellanica*.

At the end of the 19th century, two other scientific expeditions to Kerguelen Plateau were organised. In January 1893, Louis Lieutard conducted hydrographic surveys (*Eure*). Louis Lieutard met Joseph Fuller, the famous sealer from New London (USA) (*Francis Allyn*) at Kerguelen Islands. In December1898, Carl Chun made oceanographic observations at Kerguelen and Heard Islands during the German Deep Sea Expedition (*Valdivia*), but none of these visits obtained any marine specimens.

On his way to Antarctica, during the German South Polar Expedition, on board the *Gauss*, Erich D. von Drygalski called at Kerguelen and Heard Islands in January 1902. Two months earlier, another ship (*Tanglin*) coming from Australia had left a scientific party (Emil Werth, Joseph Enzenperger, Karl Luyken and two seamen) that spent 16 months on Kerguelen Islands. An outbreak of beriberi caused several deaths in the party: the two seamen and J. Enzenperger died at the beginning of 1903. Emil Werth and Karl Luyken survived and escaped aboard an Australian ship (*Stassfurt*) on 1st April 1903. This team of three scientists made meteorological and geomagnetic observations. During her passage in the zone, the *Gauss* made some local oceanographic surveys (sounding and dredging). When the *Gauss* arrived at Kerguelen (19

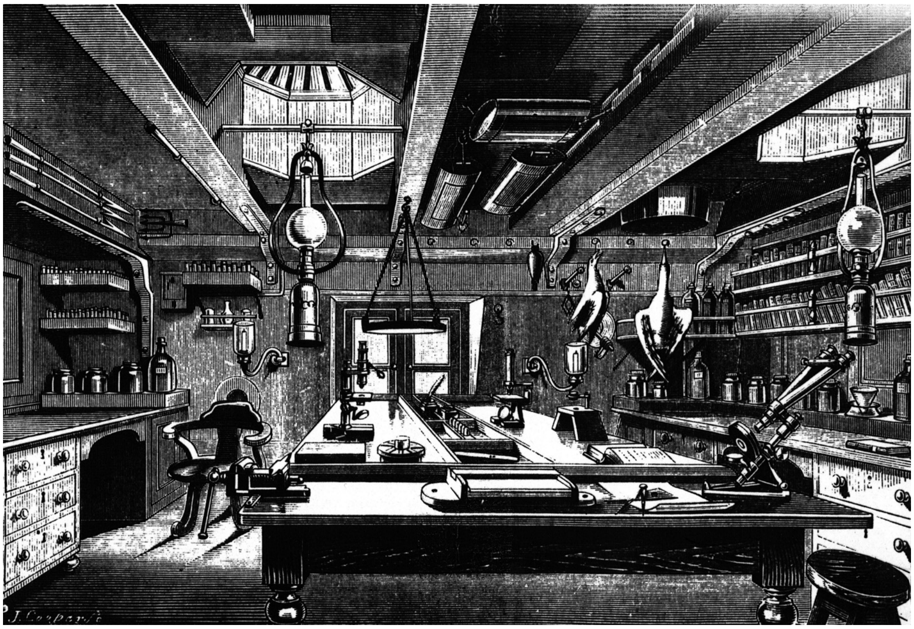

Figure 6. - HMS *Challenger*: the natural history work room.

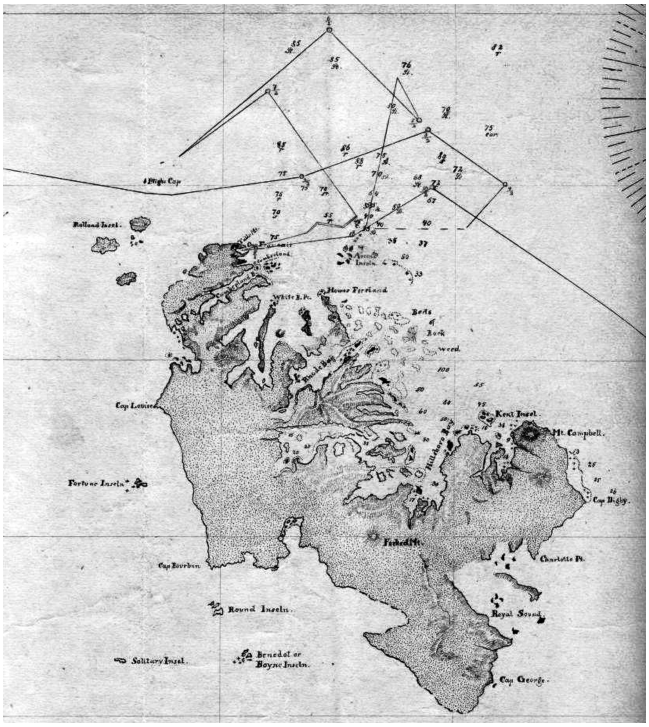

Figure 7. - *La Gazelle* stations around Kerguelen Islands.

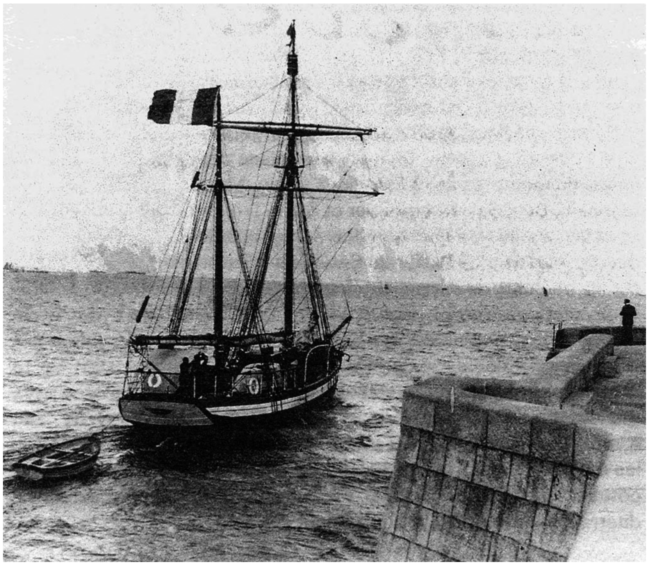

Figure 8. - *La Curieuse* of the Rallier du Baty brothers.

April 1903), the small German station was empty and the two surviving scientists were already back to Australia.

Two brothers have been famous in Kerguelen Islands, Raymond and Henri Rallier du Baty. Raymond was a member of the Charcot expedition (*Le Français*) to Antarctica in 1901-1903. In 1907-1910, they organised an exploratory expedition to Kerguelen Islands on board a small ketch (*J.-B. Charcot*). To balance their budget, these explorers and inexperienced sealers tried to exploit the elephant seals for oil but were not particularly successful in that venture. Nevertheless, during 15 months, they managed to carefully explore the eastern parts of the islands. A few years later, in 1912-1914, they conducted another topographic and hydrographic survey around the coasts of Kerguelen Islands with the ketch *La Curieuse* (Fig. 8), a boat smaller than the *J.-B. Charcot* but equipped with an additional motor. For the first time, the western and southern coasts of the archipelago were surveyed in detail (Fig. 9).

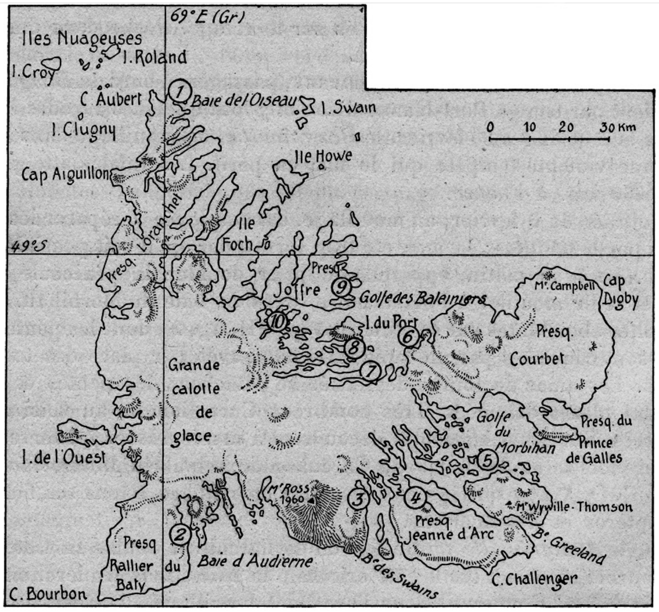

Fig. 5. Les îles Kerguelen, d'après la carte du service hydrographique de la marine. — 1. Port-Christmas. — 2. Anse de l'Armor. — 3. Plage du Radioléine. — 4. Port-Jeanne-d'Arc. — 5. Ile du Chat, Port-aux-Iles. — 6. Port-Elisabeth. — 7. Port-Couvreux. — 8. Ile du Port — 9. Port-Hopeful. — 10. Port-Louison.

Figure 9. - Map of Kerguelen Islands in 1939, according to Aubert de la Rüe (1954).

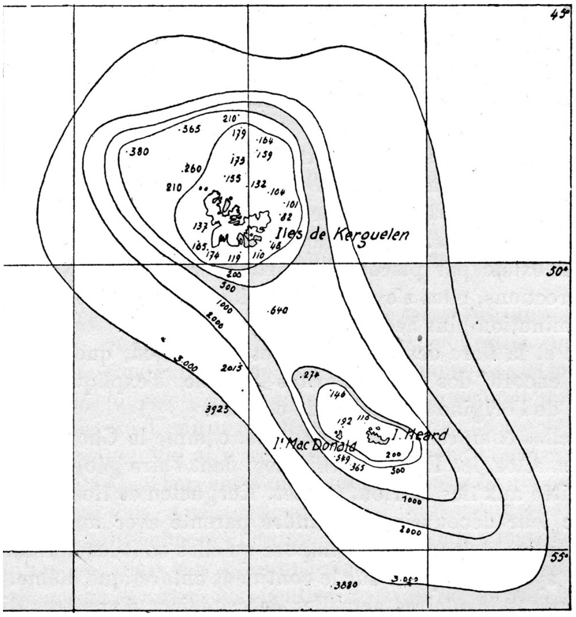

Figure 10. - The Kerguelen Plateau in 1939.

During the same period, two other brothers, Henry and Émile Bossière, in 1908-1911 attempted to develop a sheep breeding farm but without success. In association with a Norwegian company, the Bossieres established a sealing and whaling station at Port Jeanne d'Arc. It closed in 1931, after an interruption from 1915 to 1920. They surveyed the southern and western coasts of Kerguelen Islands aboard their ship *La Jeanne d'Arc*. The venture was a disaster. Their marine investigation was almost non-existent. More details about these ventures have been published by G. Delépine (1995) and Arnaud & Beurois (1996).

In 1939 the French government sent the aviso *Bougainville* around the Austral islands with two objectives: first to reassert the sovereignty of France on these islands; second to carry out a series of scientific observations. Scientists were sent on board by the Academy of Sciences, the Meteorological Office, the National Museum of Natural History, the Hydrographical Service of the Navy and the Fisheries Institute. The main surveys covered most of the scientific disciplines: hydrography, oceanography, geodesy, topography, cartography, and biology. Because of the war, only the biological results were published (Jeannel, 1940, 1941), mostly about terrestrial, freshwater and littoral fauna. Very few observations were made on the Kerguelen Plateau (Figs 9 and 10)

Just after the Second World War, some expeditions to the Southern ocean were carried out and visited the Kerguelen Plateau. In 1949-1950, the French aviso *Lapérouse* under the leadership of Pierre Sicaud was sent to Kerguelen Islands to establish a shore station (Port-aux-Français). In this occasion, the first marine biological collection was made by R. Arétas, but his main objective was the study of elephant seals. In 1950-51 and 1951-52, the *Discovery II* (from Great Britain) and the *Vercors* (from France), respectively, have made detailed oceanographic and hydrographic studies around Kerguelen and Heard Islands.

After the construction of the shore station Port-aux-Français, French marine studies on the Kerguelen Plateau have been developed. In 1957-1958, a comprehensive coastal survey (and daring voyage!) was accomplished with a small launch (*Commandant Loranchet*) all around the archipelago by seven men, lead by Yves Le Blond, over eight days. In 1961-1962, from the supply ship *Galliéni*, the first marine algological investigations and temperature measurements were carried out by the algologist René Delépine. These algological studies have been continued with several scientists each year until 1984. In 1968-1970, the first measurements of the thickness of the sediments (flexo-tirs) began.

In 1961-1962, the first ichthyological studies and fisheries investigations were implemented for the fisheries resources of *Notothenia* species, in cooperation between France and Soviet Union on board a Soviet trawler. In 1963-1964, the first ichthyological research at Kerguelen in Morbihan Bay was undertaken by Jean-Claude Hureau with very

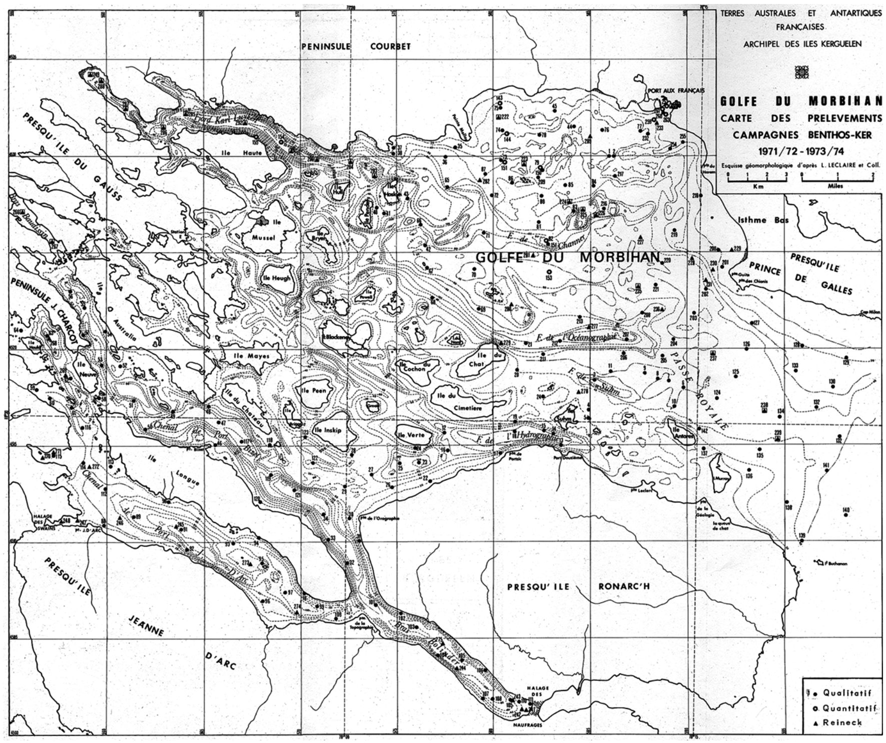

Figure 11. - Benthos stations in Morbihan Bay, Kerguelen in 1971-1974.

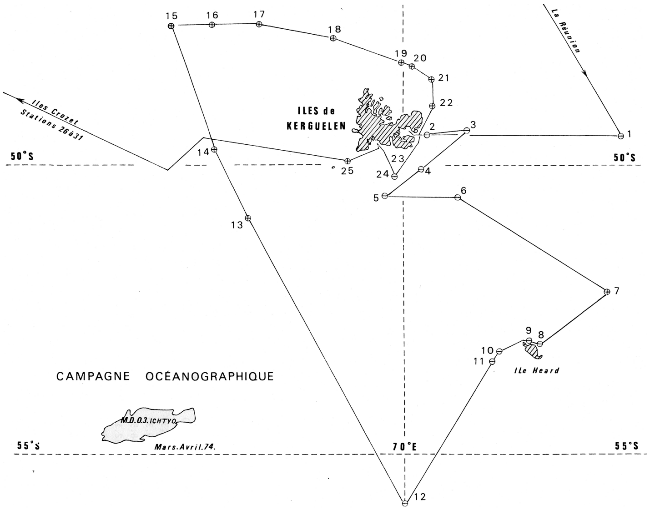

Figure 12. - Station sites of the cruise MD03/Ichtyo around Kerguelen and Crozet Islands.

limited means. The boats in use at that time were the barges *Le Gros Ventre* and *L'Oiseau*. Four species of fish have been studied in detail: *Channichthys rhinoceratus* (Richardson, 1844), *Indonotothenia cyanobrancha* (Richardson, 1844), *Paranotothenia magellanica* (Forster, 1801) and *Notothenia rossii* (Richardson, 1844) for their growth, reproduction, diet and general life cycle (Hureau, 1970). From 1964 to 2009, summer annual coastal surveys in Kerguelen have been organised to study various aspects of marine biology: microbiology (René Lésel, Daniel Delille), benthology (Paul Grua, Jacques Soyer, Daniel Desbruyères, François de Bovée, Jean-Claude Duchêne, Bertrand Richer de Forges, Patrick M. Arnaud), algology (René Delépine, Jean-François Murail) and ichthyology (Jean-Claude Hureau, Didier Petit, Catherine Ozouf-Costaz). At the beginning of this period, the work at sea was done on-board a better equipped barge,with the launch of *La Japonaise* (16 m long, 1971 to 1989) and later on with *La Curieuse* (25 m long, 1989 to 2009) in Morbihan Bay and in the coastal zones of the archipelago. Various gears were used for the benthic surveys in Morbihan Bay (Fig. 11).

In 1968, the first fish trawling survey was made with the trawling boat *Sapmer* but did not bring many valuable results. In 1973, a new oceanographic ship NO *Marion Dufresne* for the Terres australes françaises was built and replaced the old supply ship *Galliéni*. Between 1973 and 1995 this ship completed 75 scientific cruises all over the Indian Ocean, many of them on the Kerguelen Plateau. It was replaced in 1995 by the present NO *Marion Dufresne II*. Prior to the commissioning of the *Marion Dufresne*, several studies in marine biology have been published (Delépine, 1963; Hureau, 1970; Grua, 1971; Arnaud, 1974). In 1974, the first biological oceanographic cruise on board *Marion Dufresne* was set up (cruise MD03/ICHTYO under the leadership of Jean-Claude Hureau). The cruise was a preliminary ichthyological and benthic survey around Kerguelen, Heard and Crozet Islands. Thirty-one stations and 74 various samples were made between 15 and 4,225 m depth (Hureau, 1976) (Fig. 12).

In 1975, a second biological oceanographic cruise on board *Marion Dufresne* under the leadership of Alain Guille (cruise MD04/BENTHOS) was organised. The principal topics were bionomical investigations of benthos and an ichthyological survey of the Kerguelen shelf together with a qualitative and quantitative data collection on meiofauna and macrofauna (invertebrates and fish). During the cruise, 122 stations (293 samples) (Fig. 13), between 10 to 900 m depth, were made. Studies of physiology, histology of some species were carried out (Guille and Soyer, 1977). During the MD03 and MD04 cruises, a considerable programme of hydrology and primary production evaluation was made. In 1979, Jean-Claude Hureau and Patrick Arnaud led the cruise MD08/BENTHOS around Crozet, Marion and Prince

Edward Islands. The cruise formed a coherent series with MD03 and MD04.

A period of intensive exploration of the fishing grounds of the Kerguelen Plateau began at that time. Three Polish surveys were made between 1974 and 1979. On-board *Profesor Siedlecki*, J. Popiel (1974-1975) made a fishery and hydrological survey around Kerguelen Islands, Heard and McDonald Islands and Skiff Bank. In 1977-1978, Ziembo (*Manta*) investigated potential fishing grounds near Kerguelen Islands, and finally in 1979, a similar investigation was made with the *Lacerta*.

Other French biological cruises on board *Marion Dufresne* were carried out, between 1977 and 1981, before the first meeting of the scientific committee of the CCAMLR. In 1977 and 1980, Guy Jacques led the cruise MD12/antiprod (oceanography and planktonology) and the cruise MD21/antiprod 2 in order to study the primary productivity over the Kerguelen Plateau. In 1980, Jean-Claude Hureau led the cruise MD24/Biomasse around Bouvet and Kerguelen islands, as part of the preparation for the international Biological Investigations of Marine Antarctic Systems and Stocks (BIOMASS) Programme. In 1981, within the framework of that programme, Jean-Claude Hureau (*Marion Dufresne*) led the cruise MD25/FIBEX. The main objective was to detect by means of echo sounding and large plankton nets and trawls, the biomass of krill and fish present on the southern part of the Kerguelen Plateau until the limits of the Antarctic ice (Kock *et al*., 1985).

Two major events occurred in the area around this time. In 1978, France declared an exclusive economic zone (EEZ) for 200 nm around Kerguelen Islands and other sub Antarctic islands, and one year later, Australia proclaimed a 200 nm fishing zone around Heard and McDonald Islands. These EEZs have permitted the regulation of fish exploitation around the islands of the Kerguelen Plateau and a cooperative programme of research and monitoring of the fishery was established between Australia and France (Fig. 14).

During that period, a series of other fishery survey cruises occurred. In 1979, on board the *Jutland*, Guy Duhamel made fish and krill investigations off Kerguelen Islands. The same year, on board three Soviet trawlers Duhamel (*Melitopoj*), Le Petitcorps (*Ritsa*) and Duchêne (*Kadanchik*) have made fishery investigations and surveys off Kerguelen Islands and Skiff Banks. Since 1981, one or several French trawlers or longliners exploit the fishing grounds, each with a controller on-board. In 1983, Duhamel, Hureau, Le Petitcorps and Camus (on board the *Austral*) carried-out investigations off Kerguelen and Crozet Islands (Duhamel, 1984).

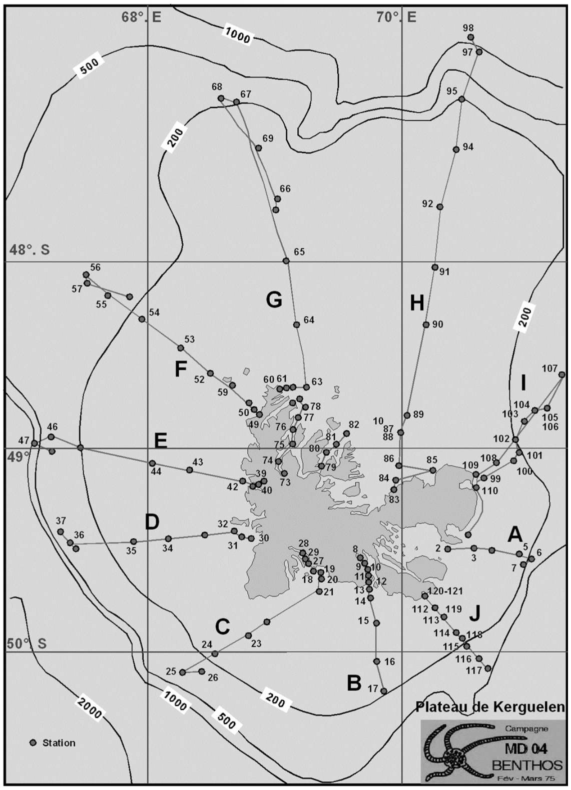

Figure 13. - Station sites of the cruise MD04/Benthos around Kerguelen Islands.

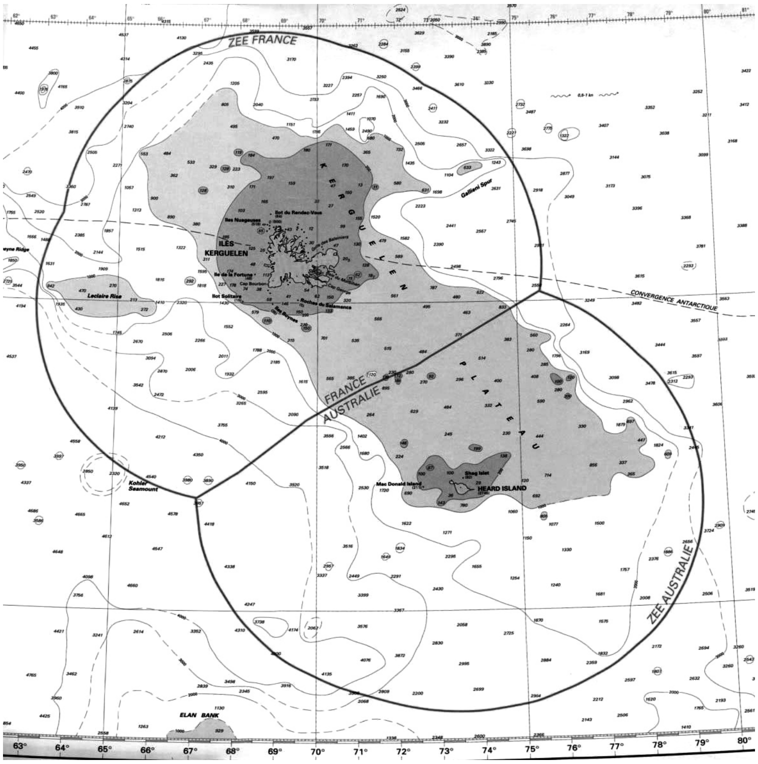

Figure 14. - Australian and French EEZ delimitations around Heard/McDonald and Kerguelen Islands. © SHOM, 2001.

Finally, on 11 September 1980, the Convention for the Conservation of Antarctic Marine Living Resources (CCAMLR) was adopted by the Contracting Parties of the Antarctic Treaty at Canberra and on 6-12 June 1982, the first meeting of the Scientific Committee of the CCAMLR was held in Hobart, Tasmania.

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